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ABSTRACT

This paper examines instructional technology as a means to achieve improvement of instruction and learning. Emphasis of recent research on technical and mechanical aspects of instructional systems is criticized because means and materials take precedence over learning objectives. It is concluded that the entire educational system, not just the instruments of instructional technology, needs to be considered in order to make the best use of modern technology to improve learning. (CH)

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METHODOLOGY AND MODELS OF LEARNING SYSTEMS

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If there is one thing that learning theorists agree upon, is that they disagree on how, why, when or where one learns. Methodology and models of learning systems are as numerous and varied as the schemas and conceptulizations of basic learning theories.

Let us begin with three fundamental assumptions:

I. Learning by whatever method or medium is definitely an individual matter. To find the perfect one-to-one relationship of achievement, innate ability, motivation and interest between two human beings is virtually impossible.

Comparative studies conducted by Myrtle McGraw in the early 30's at Columbia University Hospital of identical twins raised in diverse and separate environments from birth indicated that they not only differed in abilities and interests, but also differed physically in height, weight, attitudes, motivation and interests. Therefore, it may safely be concluded by media experts such as Charles Schuller at Michigan State University that "Groups, as such of whatever size or however dealt with, do not learn. The individuals comprising such groups do learn, however--some in spite of, others because of, the methods and media employed."

II. One of the major functions of the school, college or university is to assist students to learn. We agree that learners differ according to innate ability, rate, interest, achievement and motivation and it might be concluded that a variety of validated methods and media is necessary if we are to accommodate the individual learners.

III. The instructional systems approach by its definition, provides a more rigorous, structured, efficient, and productive means of planning than is typically utilized in education. As Schuller states, "It includes a variety of sub-systems involving learners, teachers, methods, materials and equipment interwoven and applied, as appropriate, to highly specific and measurable objectives. Individualized instruction, by a variety of means and under varied conditions, is one important component of an instructional system though by no means the only one."

The recent Ford Foundation Report entitled "An Inquiry Into the Use of Instructional Technology" labors over a "working definition" of instructional technology and very wrongly agrees that the best definition would be "the things of learning." The authors show no significant reference or substantive discussion throughout the report of systems analysis techniques and instructional systems design of self-instructional learning systems--which is what instructional technology is all about.

The 113-page report goes into some detail as to the utilization of hardware or electro-mechanical devices that instruct or enhance instruction. Little space is devoted to radio as an instruction device, yet it is the most frequently used educational medium used throughout the world today. During my visits last year to remote, traditional villages in South Africa, totally lacking in electricity and other necessities as we know them, I

found natives taking instruction via their Japanese-made mini transistor radio. Some of these courses carried college credit through the University of South Africa--the world's largest all-correspondence institution with 35,000 students enrolled in programs offering Bachelor's through the doctoral degree. Programmed instruction, the basic process underlying instructional technology, is further confused with the hardware. The exaggerated promises in the 50's and early 60's of proponents of programmed instruction fell far short of the ultimate answer to learning. Perhaps the failure was due to the misunderstanding of the role of "P.I." It is a process and not an end unto itself. Computer-based learning is treated and, like television, emphasis is placed on the technical specifications of the hardware. The final cause for concern is reference made to the "book" as a thing of learning with the statement "The book has been and for the next few decades, probably will continue to be the most widely used thing of learning." Again, references to a systems analysis technique based upon a rigorous statement of goals or objectives is missing.

Emphasis on the technical or mechanical aspects of the "things of learning" may be justified by the Ford Foundation's 10-year over emphasis on broadcast open circuit television. Research findings support that the one-way communication through educational television did not appeal to many learners. Studies of the utilization of television at the University of Minnesota indicated strong negative feelings towards this medium supporting earlier comments that groups do not learn, individuals do learn.

At a cost of $180 million, NASA recently launched the Appalachian Technology Satellite (ATS-6) signifying the marriage of educational television and satellite communication and one of today's most exciting

innovations in learning. Geographically isolated areas not adequately served by conventional communications now are linked to the instructional technology facilities prepared to initiate validated learning systems. Teaching training programs prepared at a resource center at the University of Kentucky in Lexington are sent over a land hookup to a NASA control center in Rosman, North Carolina, and there are beamed up to ATS-6. The satellite then transmits the programs back to 15 regional educational service agency sites in rural areas of Appalachia. This past summer 600 elementary teachers took satellite-beamed courses and 600 junior and senior high school teachers are now engaged in in-service training programs after school hours.

Educational institutions across the country are currently facing severe financial problems. As reflected in most sectors of society the resources are not meeting the expenses. In a recent issue of the CHRONICLE OF HIGHER EDUCATION the problem is described as follows:

> In the battle of the budget, some of the nation's top universities and several statewide systems of higher education have given up on holding the line, from Harvard to Stanford, Florida to Wisconsin, they are cutting back.

One of the few apparently valid studies on the cost-effectiveness of educational television was conducted by Edward Caffarella at the University of Maine last Spring. His studies indicate a relationship between class size and utilization of television. He points out that smaller class sizes (between 30-200) are more cost-effective when conducted in the traditional manner; cost effectiveness can be obtained with classes over 200 via utilizing closed circuit television, due to the extremely high

costs of production that open circuit or broadcast television becomes cost-effective with enrollments over 950 students.

He further concluded that airborne transmission, similar to IMPATI in the State of Indiana, can distribute television signals at a cost less than any other distribution system over large areas.

In all cases he emphasized that the cost of producing educational materials--the software--vary with the level of sophistication.

One encouraging development in the utilization of television for instructional purposes was the development of "responsive" or interactive television in the early 70's. The television being linked and driven by a mini computer allows the learner to advance at his own individual rate of learning or to be returned to a tutorial mode if he experiences difficulty. This configuration i.e., television and interactive computer, imply the necessity of systematic instructional analysis in order to develop meaningful programming. The active participation of the learner is required at all times throughout an instructional sequence.

At this point I would like to briefly comment on the use of the computer as a teaching/learning tool. Dr. John Kemeny, now President of Dartmouth and an expert in computer utilization, has stated that the "Computer is a poor substitute for a book or for a teacher." In an article appearing in LIFE magazine in the early 1960's, Dr. Patrick Suppes of Stanford referred to computers being utilized in every school and home in the United States within 10 years. There is a bit of truth in what both Kemeny and Suppes have predicted.

Recently, Dr. John Goodlad, Dean of the Graduate School of Education at U.C.L.A., speaking in Louisville said, "Instead of blaming the schools

for not meeting ever increasing expectations, Americans should ease the burden placed on schools by expanding the concept of education." He suggested that students could be educated at home through the use of a computer terminal that provides films, television, radio and self-testing.

The PLATO system developed at the University of Illinois-Urbana is the exception. Presently the system consists of 6,000 programs but 4,000 actual programs utilized on the system in 100 different disciplines. Five thousand terminal hours per day are recorded in 23 states, the District of Columbia and 1 foreign country (Sweden). Again, as an interactive instructional system, it implies the need for systematic analysis of learner needs and the true application of instructional technology.

As the Editor of a major index in the field--I prefer to use the term computer-based learning as opposed to computer assisted instruction--I must share with you my concerns:

1. Validity--The majority of computer learning programs that I reviewed--some 6,000--indicated little or minimal data regarding results of field trials, they lacked evaluation and validation studies.
2. Transferability--Many computer based learning programs were machine-designated and could not readily be transferred to other computer configurations. It is virtually impossible to assure that a computer-based program developed at one university could function at another university even with a seemingly identical computer. Standarization of equipment is virtually non-existent.

3. Sharing--Even if the computer hardware were capable of readily transferring programs from one university to another, there is a reluctance on both the part of the institution and course developer to share programs with others--particularly when validation data is lacking.
4. Cost--Computer time is expensive. The PLATO system is the exception with its claim of $1.52-$2.60 per student hour to the development of my own research in the development of a validated computer based simulation to train school administrators in competencies related to the management function ($10.50) per student hour to claims of $60 plus per student hour depending on the subject matter and computer configuration and communication linkage.
5. Acceptability--Despite the continuing advances in computer technology with speeds registered now in microseconds and pico seconds, this medium is not acceptable to needs of all learners nor understood or utilized by the majority of teachers.

We can be optimistic for the future of computer-based learning as we look at the expanded concept of networking now being developed. On the national level, Telenet and Timeshare are two such networks. In Kentucky, we are establishing the Kentucky Educational Computer Network that will supply interactive capability to all parts of the Commonwealth on a more cost-effective basis. The basic equipment required to participate in these networks is a computer terminal, a telephone coupling device and

access to a telephone line; thus it is now possible to participate in computer-based learning anywhere--be it at school or in the home.

Development of the home learning center continues, and is a hopeful wish of the hard-pressed, financially troubled educational publishing and learning industry. Breaking into the huge and profitable home market is the ultimate goal of many engaged in the commercial aspects of curriculum development, as funds for materials for instruction become less and less due to the increasingly high operating costs of the school.

The video disc, now being test marketed in Europe, will be here in a few months; however, due to the lack of acceptance of the video-cassette in the home market, video disc will concentrate on the business and industrial market. The video disc, costing $10-$50, is similar to a phonograph recording and is inserted into a device costing approximately $600 and viewed through the ordinary home television receiver.

A prototype of what might be claimed to be the first actual home use of interactive color television began last Fall in Amherst, New York, a suburb of Buffalo. Funded by an $817,000 demonstration contract received from the New York Department of Education and the Department of Health, Education and Welfare's Bureau of Education for the Handicapped, homebound handicapped children can choose from a wide range of subjects specifically designed to individual needs, proceeding at their own rate of learning in the system known as Tel-Catch (Televised Educational Lessons via Computer Assisted Instruction at Home over Cablevision to Children with Severe Handicapping Conditions). Tel-Catch is the latest application of TICCIT (Time-Shared Interactive, Computer-Controlled Information Television, a computer based instructional system developed by the Mitre Corporation.

One might well ask at this point: Exactly what is the place of new methods and sophisticated media in the instructional systems approach? It is only after terminal performance objectives are defined and a task analysis is performed--and maybe repeated--that we can address the problem of the selection of the most relevant practical method or media. Those who invest heavily in the "things of learning" whether it be computer, television, or audio tutorial laboratory equipment, and then address the problem of making the learner conform to the equipment, are destined to failure.

Another fault I find in many programs is the failure to realize that the first time around is the prototype and the final product is completed only after a field trial or evaluation phase in which the really hard question is answered. Does this learning system proport to do what I have defined in the statement of terminal performance objectives?

The instructional technolgist is interested in meaningful methodology--many times completely lacking in hardware--that is designed to meet the requirements of stated terminal performance objectives.

Competency-based curricula is now being successfully accepted throughout the nation. This movement designed to base learning on student's attainment of set competencies may be as old as learning itself. In fact, Michigan State College (now University) served as a model for the U.S. Land Grant college raised the question central to competency-based curricula--back in 1855: "How can we transfer college learning to the outside, to life?"

It wasn't until the late 1960's that competency based curriculum moved from near obscurity to visability. Emphasis on accountability

caused the U.S. Office of Education to fund ten models previously designed to train elementary school teachers. The movement was to shift teacher education to a performance base and to make demonstrated teaching competence the criterion for certification. Early success caused other disciplines to reassess this mode of learning and adopt it in various forms or modules.

There are three basic axioms that could best describe the difference between traditional and competency-based programs:

Axiom #1:

> In the traditional program time is held constant and achievement varies. In the competency-based program achievement is held constant while time varies.

Axiom #2:

> Traditional programs place greatest weight on entrance requirements. Competency-based programs place greatest stress on exit requirements.

Axom #3:

> Specify instructional objectives in behavioral terms. "If you want somebody to learn something, for heaven's sake tell him what it is!"

At the University of Louisville we recently instituted the new Bachelor of Liberal Studies Degree through our University College. Here it is possible under special circumstances to earn up to 30 hours towards the degree based upon presentation of demonstrated competency.

Throughout the nation, competency-based programs have been identified in various degrees in almost every state. In almost all cases graduation

requirements are expressed in competency level units and not semester hours.

Among institutions employing CBC in addition to U of L are:

Alverno College, Milwaukee
Antioch School of Law, Washington
Bowling Green State University, Ohio
University of Massachusetts
Florida State University

Mars Hill College in North Carolina employs a strong diagnostic testing and counseling program, but I look to the newly established Minnesota Metropolitan College to set the pace in this emerging concept.

IN SUMMARY

It is imperative that we take a holistic view of the educational environment if instructional technology is to have any ultimate impact on the concern for the improvement of teaching and learning. The focal point of a comparison of the basic components and interactions must be directed to the ultimate relationship between the teacher and learner.

Obviously, I am implying at the outset the need for the specification of learner and teacher objectives, preferably in terms of behavioral outcomes. Basically the need for the learner to understand the minimal requirements for success and the teacher to have a coordinated, validated blueprint of actions to meet the individual needs of the learner is intrinsic to a meaningful learning system.

We must provide inputs into the design of buildings and facilities for learning. We must be aware of the variety in methodology available to meet the individual needs of the learner. We must properly weigh the utilization of media with the desired learning outcomes. We must develop and utilize validated content and finally, as exemplified in

competency-based curriculum, we must not continue to hold time constant, but shift our emphasis to consistency in achievement.

Budgets and revenues to support education are in increasingly short supply. We must realize and state our priorities and how we can make the resources that we currently have go further.

Instructional technology is a means to the end and not an end in and of itself. It is a support system that implies the application of systems analysis techniques, the definition of goals and objectives that result in the improvement of and enhancement of learning at all levels.

I advocate the utilization of systems analysis applied to educational programs and agree with Robert Mager in the three points:

1. It organizes a course of study in a way that makes it easiest to carry out.

2. It provides the instructor and learner with clear objectives and the means of determining whether they have been reached.

3. It provides the learner with the periodic satisfactions that encourage him to proceed along the learning process.

"It has other applications, however, which permit it to become a large schema for many aspects of education. It helps organize and establish guidelines in the planning of administrative procedures, in the design and development of facilities, and in the projection of future needs. Guidelines for teacher training, selection, and supervision are directly influenced by the definition of educational objectives. The selection of materials for instruction and evaluation procedures are a direct result of the specification of educational objectives."

The future of educational technology will, I hope, be in the hands of the educators. The future is awesome, portentious. With technology in the hands of teachers, a great new age is possible.

The new world brought into being by instructional technology gives hope to redressing long-standing educational wrongs: inadequate opportunity, inadequate learning materials, inadequate instructional systems, inadequate motivational processes, and the inadequate recognition of the teacher as thinker and creator.

Let the winds of change blow.

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